ASSOCIATION BETWEEN SOCIAL CAPITAL AND HIV TREATMENT OUTCOMES IN SOUTH AFRICA

By
Grace Musanse Mukoswa

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School of Public Health, Faculty of Health Sciences

University of the Witwatersrand, Johannesburg

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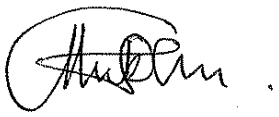
DECLARATION

I, Grace Mukoswa, declare that this research report is my own work. It is being submitted for the degree of Master of Science in the field of Epidemiology and Biostatistics at the University of the Witwatersrand, Johannesburg. No prior submissions of this material have been made for any degree or examination at this or any other university.



Grace Musanse Mukoswa
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ABSTRACT

Introduction

Social capital is seen as "the features of social organization that include civic participation, norms of reciprocity, and trust in others that facilitate cooperation for mutual benefit". There has been a growing interest in social capital and HIV treatment outcomes. However, the impact of social capital on HIV treatment outcomes remains relatively undefined. The aim of this study was to establish whether social capital is associated with HIV treatment outcomes, particularly ART adherence and virological failure, in HIV patients on ART in South Africa.

Materials and Methods

This was a cross-sectional analysis of secondary data from a cohort study that investigated how patient outcomes were linked to clinical characteristics. The cohort study was conducted at private and non-governmental (NGO) clinics that were supported by the Aurum Institute for antiretroviral therapy implementation. Participants (n=943) identified by clinic staff as being suitable for inclusion in the study (n=943) were interviewed as they exited from their clinic visit, after giving written informed consent. Questions regarding HIV adherence and perceptions around HIV and health were important determinants of adherence in this population. Participant information was linked with the database. Data analyses included descriptive statistic and logistic regression. Stata computer software version 12 was used for the analysis.

Results

Being employed and increasing age were found to be associated with social capital (p=0.01 and p=0.07, respectively). The association between social capital and visit non-adherence was not statistically significant. Social capital was, however, significantly associated with unsuppressed viral load at 12 months (OR=0.47; 95% CI=0.25-0.88) and with treatment failure at 12 months (OR=0.59; 95% CI=0.37-0.97) in the univariable analysis.

After controlling for age, marital status, education and occupation, higher social capital was still significantly associated with a lower risk of unsuppressed viral load at 12 months (OR=0.48; 95% CI=0.24-0.96) and lower risk of treatment failure at 12 months (OR=0.52; 95% CI=0.32-0.88).

Conclusion and Recommendations

This study is the first to investigate the association between social capital and HIV treatment outcomes. We found that patients in the study who were older (>40 years old) and who were employed, had higher social capital. Further research needs to be conducted to determine the relationship between social capital and HIV treatment outcomes. Public health policy-makers should adopt policies that are focused on individual younger than 18 years. Promoting youth organizations and family support is crucial to reinforce social capital in young adults. It is equally important policy to target unemployed people. Proactive decisions need to be made for the development of social networks that can facilitate and encourage collective and mutual actions and cooperation.

DEDICATION

I thank you, Lord, for all the kindness you have shown me and for always being next to me through all situations in my life; to my dear husband, Michael B Kemokai, who has never stopped believing in me; to my lovely sons, Glodi, Raphael and Gabriel.

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May God bless you. *Merci a tous!*

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ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
ANOVA	Analysis of Variance
AOR	Adjusted Odds Ratio
CD4	CD4 lymphocyte T cell count
IQR	Interquartile Range
CI	Confidence Interval
HIV	Human Immunodeficiency Virus
HIV RNA	HIV Ribonucleic Acid
NGO	Non-Governmental Organization
NRTIs	Nucleoside Reverse Transcriptase Inhibitors
NNRTIs	Non-Nucleoside Reverse Transcriptase Inhibitors
OR	Odd Ratio
Pt*	Probability for test for trend
P-value	Probability value
SD	Standard Deviation
UNAIDS	United Nations Programmes on HIV and AIDS
WHO	World Health Organization
ART	Antiretroviral Treatment.
ARV	Antiretroviral

DEFINITIONS OF TERMS

Antiretroviral treatment (ART) – a therapy used in treating HIV infection, usually given as a combination of three drugs: first line usually made up of two nucleoside reverse transcriptase inhibitors and one nucleoside reverse transcriptase (Thanker and Snow, 2003).

Social capital - the features of social organisation, such as trust, norms and networks that can improve the efficiency of society by facilitating coordinated action (Putnam, 1995).

Visit adherence - 4 to 6 visits over the first 12 months after start of ART, in this study population.

Treatment retention – a patient still on treatment twelve (12) months after start of ART.

Virological suppression – HIV RNA viral load ≤400 copies/ml at twelve (12) months after start of ART.

Virological failure – a virological rebound after complete suppression of the virus.

Virological rebound - the first viral load >400 copies/ml after achieving initial virologic suppression (<400 copies/ml).

1 INTRODUCTION

1.1 Background

Human Immunodeficiency Virus (HIV) is a virus that gradually attacks the human immune system cells. The advanced form of HIV disease is referred to as Acquired Immune Deficiency Syndrome (AIDS). The concept has played into the health outcomes among People Living with HIV/ AIDS. This group of people is considered globally to be a marginalised population.

UNAIDS (2011) published HIV/AIDS statistics for the period 2009 – 2011, showing the effects of the epidemic in sub-Saharan Africa. The same report, citing 2010 data, estimated that 68% of all people living with HIV resided in sub-Saharan Africa. The report cited that AIDS- related deaths in the region during the same year were approximately 1.2 million, and that 1.9 million people became infected with HIV. In addition, it was estimated that, in 2010, 22.9 million people in total were living with HIV in sub-Saharan Africa with an estimated 5.6 million people in South Africa (the highest number of people in any country). It was estimated that 310 000 South Africans died of AIDS-related causes, reflecting the huge number of lives that the country has lost to AIDS over the last three decades (HIV/AIDS, 2012).

HIV treatment programmes have measurabley reduced morbidity and mortality. UNAIDS (2012) reported that, in 2011, ART had expanded to cover an additional 650 000 patients in South Africa. South Africa has made remarkable progress in providing access to antiretroviral treatment (ART) and the country is currently implementing the largest ART programme in the world (WHO and UNICEF, 2011).

The South Africa 2010 country progress report had as its goal to provide an appropriate package of ART care and support services to 80% of people living with HIV and their families (Department of Health, 2010). The South African ARV programme reached 45.1% of children zero to fourteen years old in need of ART and 28.9% of young adults

(15-49 years) and 42.7% of old adult (>50 years) (Simbayi et al., 2014). A key challenge is treatment retention.

Social capital includes several aspects that are used differently across disciplines. Social capital is a concept that has been widely studied and discussed in public health over the past decade (Webel et al., 2012). In health outcomes research, social capital is justified to aid the understanding of behavioural and structural risks to particular diseases, variation in health outcomes and coping with chronic illnesses. Social capital in health research is perceived differently in the contexts of social networks and social cohesion Social networks consider both personal- and group-based social networks as well as access to resources within such networks. More specifically, social capital is seen as "the features of social organization that include civic participation, norms of reciprocity, and trust in others that facilitate cooperation for mutual benefit" (Kawachi et al., 1997). Social relations are influenced by external events. In the case of HIV, the greatest challenge may be that of stigma: social capital may reduce or increase both the perception and experience of stigma, thereby influencing HIV treatment adherence. The main pathways through which social networking might influence health outcomes include social support, social influence, social engagement, person-to-person contact, and access to material resources.

The Australian Depart of Health (Cullen and Whiteford, 2001), citing the World Bank (2001) definition of social capital, explained that, although there are varying definitions of social capital and what it encompasses, most social capital conceptualisations described the process as networks of people deriving benefit from common interaction with each other. Putnam et al. (1993) defined social capital as the "features of social organization, such as trust, norms and networks, which can improve the efficiency of society by facilitating coordinated action".

Studies have postulated that social support can influence health outcomes through provision or exchange of emotional, informational or instrumental resources in response to a perceived need or through influence on cognitions, emotions, behaviours and

biological responses that enhance health. There is a growing belief that social captital is vital in promoting HIV treatment retention. Pronyk et al. (2008) postulated that, in some settings in South Africa, high levels of social capital and community cohesion could provide protection and facilitate a more effective collective response to the HIV epidemic (Pronyk et al., 2008b) . Cene et al. (2011) provided strategies for strenghtening treatment retention tailored to available community resources/support systems with the potential to improve patient visit adherence and HIV treatment outcomes in South Africa (Cene et al., 2011). Their strategies were based on combating HIV-related stigma through various levels of interactions between individuals and their communities. Essentially, what drove the strategies included four themes based on interpersonal processes, the community structure environment, social disorder and civic engagements.

Several other reports have discussed the negative impact of social capital and HIV/AIDS on communities, including (i) the lack of privacy; (ii) the lack of anonymity in rural communities that has an impact on individuals' decisions to submit to testing for HIV infection; and (iii) refusal to attend HIV/AIDS prevention and education programmes, if they do exist. The presence of facilities and programmes in communities that target treatment of HIV/AIDS patients can be perceived as being sufficient prevention and support. There is a need for an evaluation of any preventative and support programme to determine whether people use these services. Reimer (2002) provided an example of the distinction between the presence of facilities and support programmes and the use of social capital. These distinctions were of particular importance when considering their usefulness in terms of the services they provide (Reimer, 2002). Campbell, et al. (2002) argued that frequent church attendance shows positive social capital but stopped short of considering certain religious values as a barrier that provided some strong resistance to preventive measures. These religious values restricted the teaching of sexual education, the use of condom as a preventive measure, and homosexuality (Campbell et al., 2002). (Carwein et al., 1993) and (Smith et al., 1990) went on to further discuss how people living with HIV were seen as been immoral and so deserved to be infected.

South Africa's governmental ART programme does not have a central patient monitoring and data management system. A WHO (2004) report on decentralisation of health services, indicated that central patient monitoring and data management systems were widely accepted in the policy agenda of most countries in Sub-Saharan Africa. The programme to decentralise health services, including ART programmes, in South Africa did not lead to any short-term improvement in service output, in spite of the present levels of resources. This view is supported by findings by Hanson (2000) on the decentralisation of the health sector. While decentralisation has allowed for the strengthening of decision-making at local levels, it has also become an important element in scaling up ART. Decentralisation of ART programmes can create space for innovation and community participation, making it conducive to the successful implementation of ART programmes. However, due to these challenges, information on social capital, in general, is difficult to collect in a systematic way. For these reasons, most literature [Campbell et al. (2002, 2008); Pronyk et al. (2008); Wouters et al. (2009); Cene et al. (2011); Webel et al. (2012)] on HIV/AIDS in South Africa does not include information about the impact of social capital on HIV treatment outcomes. However, by fully understanding the association between social capital and HIV, we should be able to identify which patients to focus more efforts on in terms of visit adherence, virological suppression and treatment failure. These efforts must be matched by effective support groups which could be helpful in populations with low social capital.

There are several research reports on social capital and HIV in South Africa . They include work by Pronyk et al. (2008a, 2008b), Campbell et al. (2002), and Wouters et al. (2009). Pronyk et al. (2008) looked at aspects of HIV-related psycho-socio attributes linked to social capital . They assessed whether social capital can be intentionly generated by examining the way in which economic and social gains were able to enhance individual participation in social groups (Pronyk et al., 2008a). Wouters et al. (2009) discussed the association between bridging and bonding social capital in relation to the impact they had on public disclosure by people infected by HIV (Wouters et al., 2009). They showed that bonding social capital had a positive influence on public disclosure. Campbell et al. (2008) described the chances of being infected or not infected

by HIV through group membership of funding schemes. They varied across age and gender. Young men and women belonging to a group were more likely to engage in safe sexual behavior compared to those who did not belong to a group (Campbell et al., 2002). None of these studies measured the association of social capital and HIV outcomes, however, and all suggested the need for further research in this area.

1.2 Justification for the study

The need to explore the association between social capital and HIV treatment outcomes has been suggested in several reports [Campbell et al. (2002,2008); Pronyk et al. (2008); Wouters et al. (2009); Cene et al. (2011); Webel, et al (2012)]. Their studies focused on the association between people living with HIV/AIDS and social engagements.

The current study, which aimed to determine the association between social capital and HIV/AIDS treatment outcomes in South Africa, follows from the need suggested by other researchers to further investigate the influences on HIV/AIDS treatment outcomes with regard to patients involvements in social engagements. Essentially, this work allows us to determine to what extend patients' social engagements influence their behaviour/attitudes towards treatment regimens, with subsequent implications for treatment outcomes.

Knowledge on whether social capital influences HIV/AIDS treatment outcomes would assist in the design of ART programmes. Furthermore, the assumptions are that the research findings from the associations between social capital and HIV/AIDS treatment outcomes could serve to contribute to current and future South African public health policies.

1.3 Literature review

Very few studies have looked at the association between social capital and HIV outcomes (adherence, virological suppression, and immune restoration) in South Africa. There are, however, studies in other countries that have shown associations between social factors and HIV risk/HIV adherence.

Studies conducted in developed countries on social capital and HIV/AIDS treatment outcomes include those in the United States of America (Campbell et al., 2002; Friedman et al., 2007; Kawachi et al., 1997; Webel et al., 2012; Coleman et al., 1988) and Canada (Webel et al., 2012). However, there have been more studies conducted on the association between social capital and HIV/AIDS treatment outcomes in developing countries. Studies in Africa looking at social capital include a multicentre study from sites in Botswana, Burkina Faso, Cameroon, the Democratic Republic of Congo ,Ivory Coast, Malawi, Mali, Namibia, Nigeria, Rwanda, Senegal, South Africa, Tanzania and Uganda (Mills et al., 2006), and individual sites in Zimbabwe (Gregson et al., 2011), Tanzania (Frumence et al., 2010) , Uganda (Agardh et al., 2010) and South Africa (Pronyk et al., 2008a, Pronyk et al., 2008b).

Only four of these studies looked at social aspects that might influence HIV outcomes. In a meta-analysis of studies conducted in sub-Saharan Africa and North America, high levels ART adherence were found in patients where family members and friends had a significant influence on patients by providing direct observed therapy that helped in improving and maintaining high levels of adherence to ART (Mills et al., 2006). They also measured adherence success associated with social capital in sub-Saharan Africa (Uganda, Nigeria, Senegal, Cameroon, South Africa, Botswana, Burkina Faso, Mali, Malawi, Ivory Coast, Tanzania, Democratic Republic of Congo, and Rwanda) and North America (Canada and United States of America). Social capital was described as explaining adherence successes and the threat of stigma. The preservation of social capital was observed to be important for adherence successes and the authors described the influences of social structure, infrastructure, culture, individual experience and

behaviour on HIV outcomes (Ware et al., 2009). In North America, China and Namibia, Webel et al. (2012) looked at the association between social capital and HIV outcomes amongst people living with HIV/AIDS. They found strong evidence to suggest that social capital can be used to influence health outcomes. They found that, by modifying social capital, there could be a significant improvement in HIV treatment and management (Webel et al., 2012). Weidle et al. (2006) looked at adherence to ART, measured by sustained virological suppression, in a Ugandan home-based AIDS care programme. They found high rates of sustained virological suppression amongst patients enrolled in the home-care based programme and were able to demonstrate high level adherence to ART in these patients (Weidle et al., 2006).

The study of Sivaram et al. (2009) in Chennai, India, examined the association between social capital and the social stigma of HIV/AIDS. Their results provided an insight into the association between social capital and HIV/AIDS. They found social capital indicators that were associated with reduction in fear amongst communities. This was particularly the case regarding the fear of transmission of HIV/AIDS from person to person (Sivaram et al., 2009). Another study by Frumence et al. (2014) in the Kagera Region of Tanzania examined access to social capital and the impact on reducing the risks of HIV infection. They examined the risk of HIV infection in Bukoka Urban District. Their findings revealed that individuals with high social capital were able to significantly reduce the risk of being infected by the HIV virus (described as high level of access to both cognitive and structural individual social capital) (Frumence et al., 2014).

A number of other studies have examined various aspects of social capital and the association with HIV/AIDS, all with the intention of establising the contribution to reducing social stigma associated with having been infected with the virus. Sesane et al. (2014) examined the enhancement of social capital amongst communities in South Africa and found it to be very important in reducing social stigma associated with HIV/AIDS. Their findings were focused on the role of social workers in encouraging the enhancement of social capital and its contribution to reducing social stigma. Social workers were found to have a significant influence in promoting social change in

communities. They provided essential leadership and relationships considered critical for building families and communities' capacities. Their contributions to sustainable, integrated social and economic development were judged to be remarkable. Finally, Sesane et al. (2014) found that social workers in South Africa played critical roles in combating HIV/AIDS related stigma through education and awareness (outreach programmes) which, in turn, help reduce the impact of social stigma on people living with HIV/AIDS. We can assumed from their findings that, by providing education and raising awareness through outreach programmes, there is a likelihood that these actions could create an environment for social cohesion and social participation from both the infected persons and uninfected persons. The impact of social cohesion and social participation was discussed by Fonner et al. (2014). In their study, they found that higher levels of social cohesion and social participation were associated with protective behaviours during sexual intercourse. The use of condoms and HIV/AIDS testing were the key protective behaviours. However, these protective behaviours were also found to be inversely associated with HIV-related risk factors which included social discrimination and violence against people infected by the virus or living with the virus (Fonner et al., 2014).

Although there are many definitions of social capital, for the purpose of this study, social capital was categorised into three broad groups. The categorisations are based on what Putnam et al. (1993) described as i) groups or networks, ii) trust and solidarity, and iii) collective actions and cooperation. Groups or networks are inclusive of religious groups and close friends but are not limited to these two. Trust and solidarity are encompassed by community support systems which include support from neighbours, friends and family members. Collective actions and cooperation are experienced through community action, participation and support from neighbours.

Groups and networks

Studies looking at groups and networks and HIV risk, which are specific to people living with HIV/AIDS in sub-Sahara Africa, North Africa and Asia, have reported conflicting results. Pronyk et al. (2008b) showed a negative effect; Campbell et al. (2002) showed a

negative effect in older people but a positive effect in young people; while Gregson et al. (2011) reported a negative effect amongst men and a positive effect amongst women. Other studies that showed only positive effects included those in Uganda (Agardh et al., 2010) and Zimbabwe (Gregson et al., 2011).

Trust and solidarity

Several studies have addressed trust and solidarity as an aspect of social capital. Overall, there were positive outcomes associated with HIV. Agardh et al. (2010) provided useful insight into how trust and solidarity are key social capital elements. They looked at Mbarara University students in Uganda and found that trust played a significant role in shaping sexual behaviour (Agardh et al., 2010). Campbell et al. (2002) also provided evidence of influences of trust and solidarity, through membership of community groups amongst the Carletonville community near Johannesburg in South Africa.

Collective actions and cooperation

Similarly, a few studies have addressed collective actions and cooperation, including one by Frumence et al. (2010) in Kagera Village in Tanzania, and another by Gregson et al. (2011) on women in Zimbabwe. Both studies provide useful insight about how populations with common interests can be moved to act collectively and to cooperate when faced with challenges.

Various tools have been used to measure social capital. These tools include the interview-administered questionnaires; self-administered questionnaires; focus groups, using a qualitative approach; and the measuring of responses using a priority ranking of low, medium and high social capital. There has been none that assigned a score to social capital (an actual number), as was done in this study.

1.4 Aim and objectives

The aim of the study was to establish whether social capital is associated with HIV treatment outcomes, particularly ART adherence and virological failure, in HIV patients on ART at 12 months in South Africa.

The study objectives were:

1) To describe social capital in a group of HIV-positive patients on ART treatment at 12 months.
2) To determine the association of the demographic characteristics of these patients with social capital.
3) To determine the association between social capital and virological failure at 12 months among these patients.
4) To determine the association between social capital and ART visit adherence at 12 months among these patients.

2 MATERIALS AND METHODS

2.1 Study design

This was a cross-sectional secondary data analysis of patients who were interviewed as part of a larger cohort study, to investigate how patient outcomes were linked to clinic characteristics. The objectives of the primary study were to identify clinic-level determinants of virological failure at a 12 & 24 month following start of ART among those with viral load results, controlling for individual determinants and to identify clinic-level determinants of non-death losses in patients after starting ART, controlling for individual determinants.

2.2 Study setting

From January 2006 to December 2010, a large cohort study was conducted by the Aurum Institute, at private and non-governmental organisation (NGO) clinics that it supports for ART implementation. Patients were enrolled at 36 clinics (see Figure 1) which were part of the Aurum-managed programme funded by the President's Emergency Plan for AIDS. The study was conducted to investigate how patient outcomes were linked to clinic characteristics.

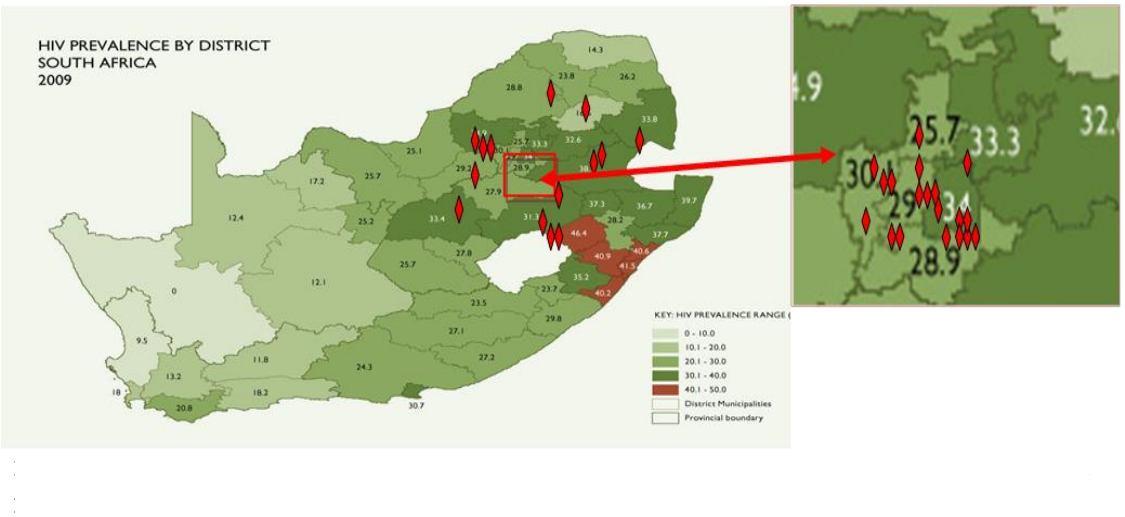

Figure 1. Distribution of study clinics (represented by diamonds) against a backdrop of antenatal prevalence by district (Source: Aurum Institute, 2009).

2.3 Study population and sampling

The study population of the primary study comprised adult HIV positive males and females, older than 18 years, attending the afore-mentioned clinics, who were on ART for more than one month. Patients identified by clinic staff as being suitable for inclusion in the study (n=943), were interviewed as they exited from their first clinic visit, after giving written informed consent to participate in the primary study. Demographic characteristics, as well as issues regarding experiences of the service and patient-provider

interaction, were collected. Patients, who were unable to speak any of the languages that the interviewers were able to speak, were excluded from the primary study.

Clinics were chosen if they had more than 80 patients that had initiated ART during the study period of 12 months, and were located in five provinces in South Africa, namely Gauteng, North West, Free State, Limpopo and Mpumalanga provinces. Of the clinics, 17 were located in towns, 14 in cities and three in rural areas. Twenty-five clinics were run by private solo practitioners, six were private group practices, and three were NGO clinics.

2.4 Measurement

It is important to emphasise that we were not able to identify a validated tool for measuring social capital. Questionnaires were collected to determine social capital as defined by group and network; trust and solidarity; and cooperation and collective action. The questionnaires included questions concerning each type of social capital as defined above and scores were assigned to responses. Responses to questions regarding HIV adherence and perceptions around HIV and health from a previous study (Dahab et al., 2008) were important determinants of adherence in this population. These questions were obtained from a questionnaire previously used in this population. We also used questions to measure treatment literacy to understand HIV/AIDS and all aspects of ART, barriers to access and perceptions of the health service, also obtained from a questionnaire previously used in South Africa (Schneider et al., 2008).

Routine data that were collected as part of the programme, from patients at each clinic visit after initiation of ART, including demographic information and information related to adverse effects and changes in treatment (recorded on the case report forms), were also included in the analysis reported here. The coding on the questionnaire of the primary study was the inverse to the coding used for the analysis of the secondary study (see Appendix 1 for questions used from the primary study).

2.4.1 Outcome and predictor variables

Outcomes (dependent variables):

The outcomes for the analysis reported here were visit non-adherence, unsuppressed viral load, and treatment failure. Visit non-adherence was defined as fewer than five visits in the first year after start of ART. Visits following ART initiation were scheduled at 2 weeks, 6 weeks, 3 months, 6 months, 9 months and 12 months (i.e. 7 visits in the first year, including the ART initiation visit). Unsuppressed viral load was defined as HIV RNA viral load >400 copies/ml at 12 months after start of ART among those who had a viral load result. Treatment failure was defined as either no viral load result or viral load >400 copies/ml after 12 months. The three outcomes were dichotomised into 'adherence' and 'non adherence'; 'suppressed' and 'unsuppressed'; and 'yes' and 'no', respectively.

Predictors (independent variables):

Social capital was the main predictor variable (exposure variable) and was defined as low (score of <14), medium (score 15-22), or high (score 23-38).

Potential confounders:

Age (years) was categorised into three groups, viz. 'younger than 30', '30-40' and ‘older than 40'. Gender was classified as male and female. Education level was categorised as 'completed primary school', 'completed secondary school’ and 'undergraduate'. Occupation was categorised as 'employed' and 'unemployed'. Socio-economic status was assessed by type of residence (based on factors such as type of house, main material used for walls, roof, etc), wealth/income (number of rooms in the house, toilet facility, sources of water, sources of energy, ownership, eating habits, etc), and health (belonging to a medical aid, etc).

Socio-economic status scores ranged from 8 to 21. Individuals who had accumulated scores of 16-21, 10-15 and 8-9 were classified as belonging to low, middle and high socio-economic groups, respectively. Other variables such as marital status, migration, nationality, languages are shown in the tables in the Results section.

Table 1. Scores allocated to responses to questions about social capital

Social capital variable	Question	Coding on questionnaire of primary study			Score given for analysis of secondary study			Total possible score	Section Total
Groups and networks	Are most of the members of these groups the same?		Yes	No		Yes	No	6	
		Religion	1	0	Religion	0	1		
		Gender	1	0	Gender	0	1		
		Race	1	0	Race	0	1		
		Ethnicity	1	0	Ethnicity	0	1		
		Occupation	1	0	Occupation	0	1		
		Education	1	0	Education	0	1		
	How many close friends do you have these days and can feel at ease with when talking to them about private matter or calling on them for help?	Number recorded as per response			Number If >5 friends, then record 5			5	
	How many such groups do you or members of household belong to and which of the group are most important to your household?	Number recorded as per response			Number If > 5 groups, then record 5			5	16
Trust and solidarity	Generally speaking, would you say that most people can be trusted?	Yes 1		No 0	Yes 5	N 0		5	
	What is the level of trust between the community and the following types of people or groups? 1. Neighbours 2. Strangers 3. News Papers/TV 4. National Leaders 5. Police	No trust = 1 Low trust = 2 Medium trust = 3 High trust = 4 Complete trust = 5			No trust = 1 Low trust = 2 Medium trust = 3 High trust = 4 Complete trust = 5			5	30

Collective action and cooperation	If you suddenly needed to borrow a small amount of money, are there people beyond your immediate household and close relatives to whom you could turn to and they would be willing and able to provide this money?	Definitely = 1 Probably = 2 Unsure = 3 Probably not = 4 Definitely not = 5	Definitely = 5 Probably = 4 Unsure = 3 Probably not = 2 Definitely not = 1	5	
	If a community project does not directly benefit you but has benefits for many others in the village/neighbourhood, a) Would you contribute time to the project? b) Would you contribute money to the project?	Yes = 1 No = 0	Yes=5 No=0	5	
	If you suddenly you had to go away for a day or two, who would take care of your children?	Blood relative = 1 Other relatives = 2 A non-relative close friend = 3 Neighbour = 4 Work colleague = 5 Member of a group you belong to = 6 No one = 7	Blood relative = 2 Other relatives = 2 A non-relative close friend = 5 Neighbour = 5 Work colleague = 5 Member of a group you belong to = 5 No one = 0	5	
					15
Total					61

2.5 Data analysis

2.5.1 Data merging

In this study, we linked the participant information with the social capital and outcome database. After merging, we looked at the HIV treatment outcomes of the participants' outcomes from the start of treatment to 12 months after starting treatment.

2.5.2 Social capital

Table 1 shows the questions that were asked in the questionnaire relating to each social capital variable, how the answers were scored, and the total possible score for each question. A study participant could have a high, medium or low level score in each of these three groups of social capital. For groups and networks, low social capital was defined by a score of <2, medium by a score of 3 – 7, and high by a score of 8 - 21. For trust and solidarity, low social capital was defined by a score of <1, medium by a score of 2 – 6, and high by a score of was 7-10. For collective actions and cooperation, low social capital was defined by a score of <8, medium by a score of 9 - 12, and high by a score of 13 - 15. Low overall social capital was defined by a score of <14, medium by a score of 15 - 22, and high by a score of 23 - 38.

2.5.3 Descriptive statistics

Social capital was described by demographic factors, such as gender, age group, etc. Levels of social capital were grouped using the frequency centiles: for high, middle and low social capital, >75th, 25th to 75th and <25th centiles were used, respectively. The social capital factors measured were also used to determine to what extent a particular level of social capital influenced visit non-adherence, viral suppression and treatment failure.

Categorical variables were summarised using frequencies and percentages, such as gender, age group, marital status, nationality, occupation, languages, education and socio-economic status. Continuous variables were summarised using means and standard deviations. ANOVA tests were used in determining differences in the means or medians of the groups.

2.5.4 Inferential statistics

Odds ratios in a logistic regression model were calculated for categorical variables and, where a trend was evident, a chi-square test for trend was conducted. Variables that were noted to significantly confound the association with any of the three treatment outcomes were included in the final model.

Univariable analyses were used to test for the associations between social capital and HIV treatment outcomes. A p-value of ≤ 0.2 was used for selection of variables to include in the multivariable model as confounders. The criteria used to identify a confounder were that the variable had to be associated with the exposure (social capital), but independently associated with one of the three HIV treatment outcomes; and that it should not be on a causal pathway. Moreover, in a stratified analysis, the stratum odd ratios (ORs) had to be similar, but different from the crude ORs.

2.6 Ethical considerations

Ethical clearance for the primary study was obtained from the Human Research Ethics Committee of the University of the Witwatersrand and the Ethics Committee of the London School of Hygiene and Tropical Medicine. Clearance for the secondary analysis of the data was obtained from the University of the Witwatersrand Human Research Ethics Committee (clearance certificate number M130240 - see Appendix 2). Permission to use the data was granted by the Aurum Institute after signing a confidentiality and non-disclosure form. The Aurum Institute provided anonymous data for analysis.

All information obtained during the course of the study was held securely. The data were analysed as individual data. No one outside of the study team had access to any of the information.

3 RESULTS

3.1 Descriptive statistics

3.1.1 Demographic characteristics

A total of 1 324 HIV positive adults were included in the study, of whom 946 (71.5%) were female (Table 2); the average age was 40 years (SD±8.9). The majority of the study participants were South African (n=1 213; 91.6%), the most common language was Zulu (n=440; 33.2%), and most participants had a high school diploma (n=651; 49.1%).

Although 56.9% (n=700) reported that they were unemployed, the majority of participants fell into the medium socio-economic status group (n=355; 62.6%).

Table 2. Demographic characteristics of study participants (N = 1 324)

Factors	Level	N	%
Gender	Female	946	71.5
	Male	378	28.6
Age(years)	<30	176	13.3
	30-40	599	45.2
	>40	549	41.5
Language	Zulu	440	33.2
	Sesotho	237	17.9
	Tswana	231	17.5
	Sepedi	144	10.9
	Xhosa	93	7.0
	Other *	179	13.5
Nationality	South African	1 213	91.6
	Other**	111	8.4
Marital status	Never married	613	46.3
	Married	336	25.4
	Widow/widower	144	10.9
	Living together	131	9.9
	Divorced	100	7.6
Occupation	Unemployed	700	56.9
	Employed	624	43.1

Living (with)	Alone	1 071	80.9
	Partner	253	19.1
Education	Primary	132	9.9
	Secondary	651	49.2
	Undergraduate	541	40.9
Migration	SA Citizen	949	71.9
	Immigrant	375	28.3
Socio-economic status***	Low	32	5.6
	Medium	355	62.6
	High	180	31.8

***English, Afrikaans, Venda, Ndebele, SiSwati and Tsonga**

**** Zimbabwean, Mozambican, Lesotho, Malawian, Botswana, Nigerian and Ghanaian**

*****Measurements of SES were assessed by type of residence, wealth and income, etc.**

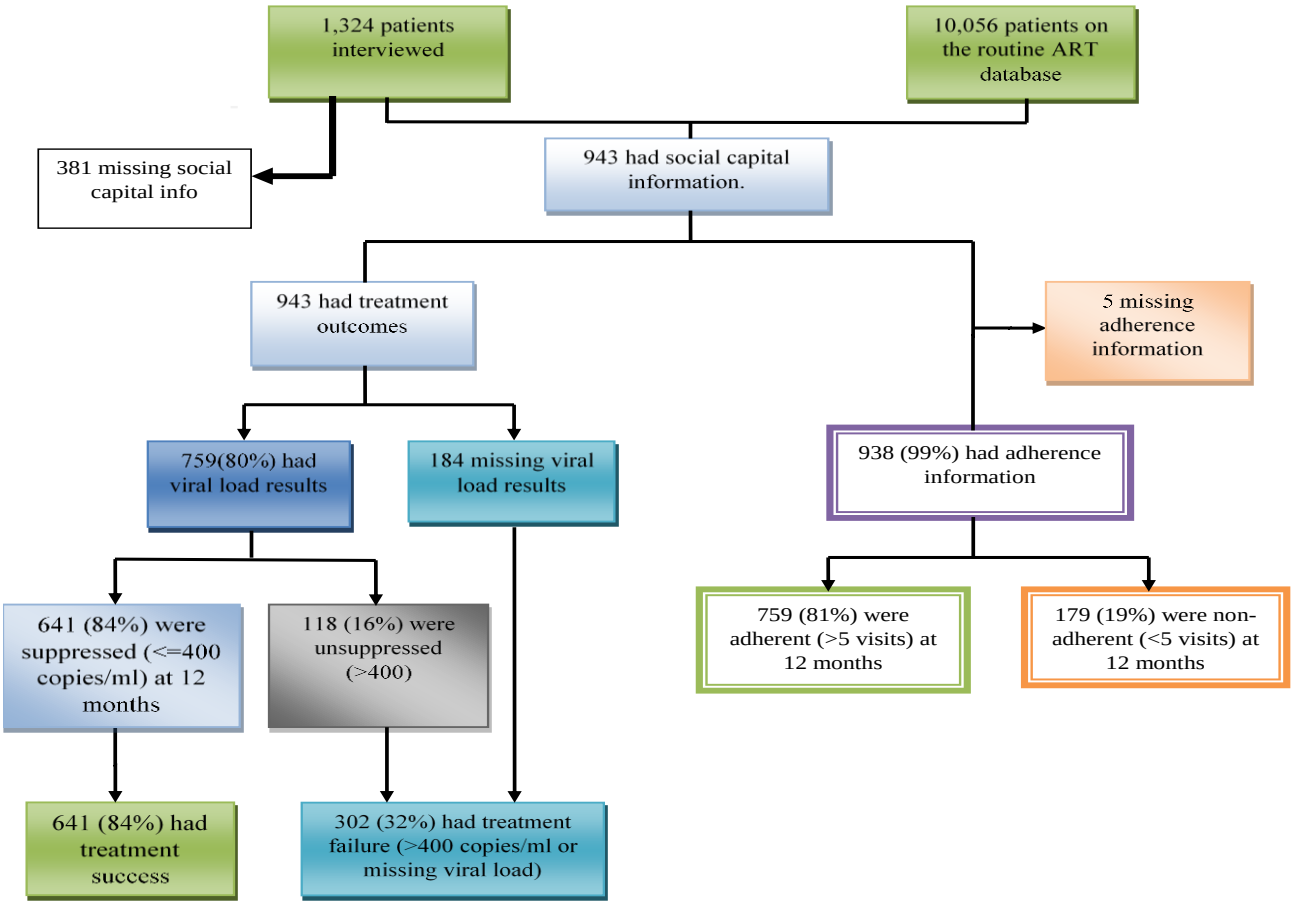

Figure 2. Number and proportions of participants in study at various stages

Figure 2 shows the number and proportions of participants in the study at various stages. Of the 1 324 patients interviewed, 943 (71.2%) had treatment outcome data available, 759 (80.1%) had viral load results at 12 months, and 184 (13.8%) had missing viral load results. For the 759 (80.1%) viral load results, 641 (84.5%) were suppressed (<=400 copies/ml) and 118 (15.6%) were unsuppressed (>400 copies/ml). There were data on adherence at 12 months available for most of the participants (n = 938; 99.9%): 759 (80.9%) were adherent and 179 (19.1%) were non adherent.

3.1.2 Social capital

Social capital was measured in 943 of the study participants.

Groups: When asked about whether the person or a member of his/her family was part of a group, The most important group to most people was member of their households (for 86.2% of participants), and a member of their households were either part of one group; 63 (10.1%) or part of two groups; 16 (2.6%) or part of three groups; and seven (1.1 %) were part of more than three groups. Of those belonging to a group, 240 (38.3%) had members who were the same gender, 128 (20.5%) came from the same religion, 118 (19.2%) were of the same race, 199 (32.0%) were from the same ethnicity, 336 (53.9%) had the same occupation, and 334 (53.6%) had the same education. Of all participants, 130 (21.1%) had no friends, 475 (75.5%) had five or fewer friends, and 21 (3.4%) had more than five friends.

Trust: When asked if, generally, "most people can be trusted", only 167 (26.7%) said yes. Participants were asked about their opinion on the level of trust in the community and between different types of people or groups. On a scale of 1 to 5, where 1 was no trust and 5 was complete trust, neighbours scored a median of 2 and strangers a median of 1, which implied low and complete lack of trust, respectively. Media, national leaders and police scored a median of 3 which indicated medium trust.

Cooperation: When asked if there were people who might be able to lend money to the participant, 477 (76.6%) said they would definitely or probably be able to borrow a small amount of money, 86 (13.6%) did not respond or were unsure, and 62 (9.7%) said they would probably not or definitely not be able to borrow a small amount of money. Of all the respondents, 74.2% and 59.6%, respectively, agreed that they would contribute their time and money to projects that would not benefit them directly but were beneficial to the community as a whole.

When asked who would take care of their children if they had to suddenly go away for a day or two, 490 (78.1%) said relatives, 49 (7.9%) said non-relatives, and 87 (14.1%) said that there was no one who would do this.

Baseline characteristics of patients according to social capital groups are reported in Table 3. Being employed was found to be significantly associated with social capital (p=0.01). Increasing age of the study participants was also associated with social capital (p=0.07), although this was not statistically significant.

3.1.3 Confounders

After investigating for confounders, using Mantel Haenszel Methods, it was established that none of the above predictors was a confounder for the relationship (association between treatment failure/ unsuppressed viral load and social capital). However, the association between visit non-adherence and social capital was confounded by employment. The final model was built by forward elimination.

Table 3. Baseline characteristics of patients according to different social capital group measures

Variable	n	Group and networks (mean)	Trust and solidarity (mean)	Cooperation and collective action (mean)	Total Social capital (mean)	P value*
Age (years)						0.07**
<30	68	4.40	3.59	9.63	17.62	
30 - 40	279	4.61	3.48	10.15	18.23	
>40	264	4.73	3.91	9.69	18.36	
Gender						0.23***
Female	465	4.68	3.67	10.02	18.38	
Male	146	4.51	3.72	9.47	17.70	
Marital status						0.31**
Living together	46	5.28	4.78	9.89	19.96	
Married	155	4.73	3.79	10.21	18.73	
Divorced	47	4.57	4.17	10.15	18.89	
Never married	293	4.52	3.37	9.58	17.49	
Widow/Widower	70	4.54	3.64	10.36	18.54	
Nationality						0.47***
South African	598	4.64	3.67	9.88	18.20	
Other	13	4.54	3.84	10.54	18.92	
Occupation						0.01***
Employed	254	5.24	3.52	10.17	18.94	
Unemployed	357	4.21	3.79	9.69	17.71	
Language						0.59**
Sepedi	110	5.58	3.00	10.01	18.59	
Tswana	111	5.09	3.16	9.54	17.80	
Zulu	149	4.62	4.33	10.12	19.07	
Others	73	4.41	4.30	9.92	18.61	
Xhosa	33	4.12	3.91	9.51	17.55	
Sesotho	135	3.76	3.55	9.92	17.27	
Education						0.72**
Tertiary	258	5.08	3.43	10.19	18.70	
Secondary	283	4.35	3.85	9.76	17.98	
Primary	70	4.19	3.90	9.33	17.41	
Migration status						0.46***
Immigrant	113	5.00	3.55	9.29	18.30	
SA Citizen	498	4.56	3.71	10.03	17.84	
Socio-economic status						0.60**
Medium	353	4.83	3.78	9.94	18.56	
High	179	4.67	3.47	10.04	18.19	
Low	32	4.53	4.16	10.19	18.88	

***P value for total social capital**

****Anova test**

*****T-test**

3.2 Social capital factors affecting HIV treatment outcomes

Table 4 shows the results of the analysis of the association of various factors with visit non-adherence. In the univariable analysis, use of Tenofovir in the regimen was associated with visit non-adherence (0R=0.55; 95% CI=0.35-0.88). However, socio-economic status, age, marital status, occupation, living single, gender, languages, education, migration, WHO stages, and NNRTIs regimen were not associated with visit non-adherence.

Table 4. Univariable and multivariable logistic regression analyses models for non-adherence (fewer than 5 visits) at 12 months (N=938)

	Total		Visit non-adherence		Univariable analysis			Multivariable analysis		
Variable	**N**	**%**	**n**	**%**	**OR**	**95% CI**	**P-Value**	**OR**	**95% CI**	**P-Value**
Age (years)										
<30	100	11	20	20	1 (Ref)		-	-	-	-
30 - 40	412	44	78	19	0.93	0.54-1.62	0.80	-	-	-
>40	426	45	81	19	0.94	0.54-1.62	0.82	-	-	-
Gender										
Male	277	30	54	19	1 (Ref)		-	-	-	-
Female	661	70	125	19	0.96	0.67-1.37	0.84	-	-	-
Marital status									-	
Married	241	26	43	18	1 (Ref)		-	-	-	-
Partner	97	10	11	11	0.59	0. 29-1.20	0.14	-	-	-
Widow/widower	109	12	25	23	1.37	0.79-2.39	0.27	-	-	-
Divorced	74	8	16	22	1.27	0.67- 2.41	0.47	-	-	-
Single	417	44	84	20	1.16	0.77-1.75	0.47	-	-	-
Nationality										
South African	869	93	163	19	1(Ref)		-	-	-	-
Other	69	7	16	9	1.31	0.73-2.35	0.37	-	-	-
Living (with)									-	
Partner	757	81	146	19	1(Ref)		-	-	-	-
Alone	181	20	33	18	0.93	0.61-1.42	0.75	-	-	-
Language										
Sesotho	171	18	32	19	1(Ref)		-	-	-	-
Xhosa	68	7	13	19	1.02	0.50- 2.10	0.94	-	-	-
Sepedi	105	11	15	14	0.72	0.37-1.41	0.34	-	-	-
Zulu	290	31	50	17	0.90	0.55- 1.47	0.69	-	-	-
Tswana	176	19	38	22	1.19	0.71-2.02	0.51	-	-	-
Others	128	14	31	24	1.39	0.79- 2.43	0.25	-	-	-
Education							**Pt*= 0.22**			
Primary	93	10	17	18	1(Ref)		-	-	-	-
Secondary	461	49	99	21	1.22	0.69-2.16	0.49	-	-	-
undergraduate	384	41	63	16	0.88	0.49-1.58	0.67	-	-	-

Migration status										
SA citizen	673	72	127	19	1(Ref)		-	-	-	-
Immigrant	265	28	52	20	1.04	0.73- 1.50	0.40	-	-	-
Occupation										
Unemployed	529	56	98	19	1(Ref)		-	-	-	-
Employed	409	44	81	20	1.09	0.78- 1.50	0.62	-	-	-
Socio-economic status										
High	130	32	25	19	1(Ref)		-	-	-	-
Medium	255	62	32	13	0.60	0.34-1.06	0.08	0.59	0.33- 1.06	0.08
Low	23	6	0	0	-		-	-	-	-
WHO stages										
Stage 1	174	19	35	20	1(Ref)			-	-	-
Stage 2	246	26	46	18	0.91	0.55-1.49	0.72	-	-	-
Stage 3	336	36	52	15	0.72	0.45-1.17	0.19	-	-	-
Stage 4	182	19	46	25	1.34	0.81-2.21	0.25	-	-	-
NRTI regimen**										
Zidovudine(AZT)	103	11	29	28	1(Ref)		-	1.(Ref)	-	-
Tenofovir	820	87	147	18	0.55	0.35-0.88	0.01	1.26	0.47-3.40	0.65
Stavudine (D4T)	15	1.60	3	20	0.63	0.17-2.43	0.51	1.29	1.12-13.76	0.82
NNRTI regimen***										
Efavirenz	452	49	88	19	1(Ref)		-	-	-	-
Nevirapine	466	51	88	19	0.96	0.69-1.34	0.82	-	-	-
Group and Network										
Low	143	33	25	17	1 (Ref)		-	-	-	-
Medium	208	47	29	14	0.78	0.44 – 1.40	-	-	-	-
High	91	21	9	10	0.53	0.24 – 1.19	-	-	-	-
Trust and Solidarity										
Low	109	24	181	17	1 (Ref)		-	-	-	-
Medium	239	54	33	14	0.81	0.43 – 1.51	-	-	-	-
High	97	22	12	12	0.71	0.32 – 1.57	-	-	-	-
Collective Action and Cooperation										
Low	119	27	21	18	1 (Ref)			-	-	-
Medium	300	68	28	13	0.68	0.38 – 1.21		-	-	-
High	25	6	4	16	0.68	0.28 – 2.86		-	-	-

Social Capital							**Pt*= 0.33**			
Low	118	27	19	16	1(Ref)		-	1.(Ref)	-	-
Medium	221	50	32	14	0.88	0.48- 1.64	0.69	0.92	0.47-1.82	0.81
High	104	23	12	12	0.68	0.31-1.47	0.33	0.81	0.36-1.87	0.63
CD4 baseline										
<200	934	100	179	19	-	-	-	-	-	-
200	4	0.43	0	0	-	-	-	-	-	-

***P trend **Nucleoside reverse transcriptase inhibitors ***Non-nucleoside reverse transcriptase inhibitors.**

In the multivariable model, none of the variables was associated with visit non-adherence. Social capital was also not associated with visit non-adherence in either the univariable or multivariable analysis.

Table 5 provides the results of the analysis of the associations with unsuppressed viral load (>400 copies/ml) at 12 months for all those who had a viral load result. In the univariable analysis, being older than 40 years (OR=0.49; 95% CI=0.26-0.91) and being employed (OR=0.57; 95% CI=0.38-0.86) were associated with lower risk of unsuppressed viral load. However, the following factors were associated with increased risk of having an unsuppressed viral load: being single (OR=1.80; 95% CI=1.07-3.03), speaking Tswana and other languages as home languages compared to Sesotho (OR=2.09; 95% CI=1.03-4.25 and OR=2.14; 95% CI=1.00-4.57, respectively), and use of a nevirapine in the regimen (OR=1.57; 95% CI=1.04-2.36).

Table 5. Univariable and Multivariable logistic regression analyses model for unsuppressed viral load (VL>400 copies at 12 months) (N= 759)

Variable	Total		Unsuppressed viral load		Univariable analysis			Multivariable analysis		
	N	%	n	%	OR	95% CI	PValue	OR	95% CI	P Value
Age							**Pt*= 0.01**			**Pt*= 0.70**
<30	76	10	17	22	1 (Ref)		-	1 (Ref)		-
30 - 40	333	44	58	17	0.73	0.40-1.35	0.32	1.07	0.34-3.34	0.91
>40	350	46	43	12	0.49	0.26- 0.91	0.02	0.92	0.28- 3.04	0.90
Gender										
Male	219	29	33	15	1 (Ref)		-	-		-
Female	540	72	85	16	1.05	0.68- 1.63	0.81	-		-
Marital status										
Married	188	25	22	12	1 (Ref)		-	1 (Ref)		-
Living together	78	10	12	16	1.37	0.64-2.93	0.41	1.89	0.57-6.28	0.30
Widow/widower	97	13	12	12	1.07	0.50-2.26	0.87	0.49	0.14-1.69	0.26
Divorced	59	8	8	14	1.02	0.41-2.51	0.97	1.18	0.35-3.95	0.78
Single	337	44	64	19	1.80	1.07- 3.03	0.03	1.14	0.53- 2.48	0.73
Nationality										
South African	703	93	112	16	1 (Ref)		-	-		-
Others	56	7	6	11	0 .63	0.27-1.51	0.30	-		-
Living (with)										
Partner	143	19	103	11	1 (Ref)		-	1 (Ref)		-
Alone	616	81	15	17	1.71	0.96- 3.05	0.07	0.53	0.57-6.28	0.23
Language										
Sesotho	133	18	13	10	1 (Ref)		-	1 (Ref)		-
Xhosa	52	7	8	17	1.93	0.77- 4.84	0.16	1.05	0.24- 4.53	0.95
Sepedi	80	11	13	16	1.79	0.79-4.09	0.17	1.80	0.67-4.80	0.24
Zulu	247	33	37	15	1.63	0.83-3.18	0.16	1.14	0.42-3.10	0.79
Tswana	146	19	27	19	2.09	1.03-4.25	0.04	1.78	0.70-4.53	0.23
Others	101	13	19	19	2.14	1.00-4.57	0.05	2.6	0.77-6.60	0.49

Education										
Primary	73	10	7	10	1 (Ref)		-	1 (Ref)		-
Secondary	372	40	67	18	2.07	0.91-4.72	0.08	1.92	0.65-5.67	1.19
undergraduate	314	41	44	14	1.54	0.66-3.57	0.32	0.92	0.29-2.98	0.89
Migrant										
Citizen	537	71	36	16	1 (Ref)		-	-		-
immigrant	222	29	82	15	1.07	0.70-1.65	0.74	-		-
Occupation										
Unemployed	408	54	82	19	1 (Ref)		-	1.(Ref)		-
Employed	351	46	36	12	0.57	0.38- 0.86	0.01	0.60	0.31-1.14	0.12
Socio-economic status										
High	97	29	17	18	1 (Ref)		-	-		-
Medium	215	65	36	17	1.05	0.55- 2.00	0.88	-		-
Low	20	6	6	30	2.17	0.72- 6.49	0.17	-		-
WHO stages							**Pt*= 0.79**			
Stage 1	151	20	25	17	1 (Ref)		-	-		-
Stage 2	187	27	29	16	0.92	0.52-1.66	0.79	-		-
Stage 3	275	36	41	15	0.88	0.51- 1.52	0.65	-		-
Stage 4	146	19	23	16	1.21	0.77- 1.90	0.41	-		-
NRTI regimen**										
Zidovudine(AZT)	92	12	16	17	1 (Ref)			-		-
Tenofovir	655	86	100	15	0.85	0.48- 1.53	0.60	-		-
Stavudine (D4T)	12	2	2.()	17	0.95	0.19-4.76	0.95	-		-
NNRTI regimen**										
Efavirenz	367	49	46		1 (Ref)		-	1.(Ref)		-
Nevirapine	375	51	69	18	1.57	1.04- 2.36	0.03	1.56	0.84-2.87	0.16
Group and Network										
Low	109	30	22	20	1 (Ref)		-	-		-
Medium	170	47	26	15	071	0.38 – 1.34	-	-		-
High	80	22	13	16	0.77	0.36 – 1.63	-	-		-

Trust and Solidarity										
Low	95	26	15	16	1 (Ref)		-	-		-
Medium	185	52	37	20	1.33	0.69 – 2.57	-	-		-
High	79	22	9	11	0.69	0.28 – 1.66	-	-		-
Collective Action and Cooperation										
Low	92	26	20	22	1 (Ref)		-	-		-
Medium	246	69	38	15	1.33	0.69 – 2.57	-	-		-
High	20	6	3	15			-	-		-
Social Capital										
Low	91	25	23	25	1 (Ref)		-	1 (Ref)		-
Medium	180	50	25	14	0.47	0.25- 0.88	0.02	0.48	0.24-0.96	0.04
High	87	24	13	15	0.51	0.24- 1.09	0.08	0.69	0.30-1.57	0.38
CD4 baseline										
<200	756	100	118	16	1 (Ref)			-		-
200	3	0	0	0	1			-		-

***P trend**

Social capital was associated with lower risk of unsuppressed viral load in both the univariable and multivariable analysis. In the multivariable analysis, controlling for age, marital status, occupation, languages, living single, education and NNRTI, social capital was still associated with lower risk of unsuppressed viral load at 12 months (OR=0.48; 95% CI=0.24-0.96). There was a trend association between social capital and decreasing age (p=0.01).

Table 6 shows the results of the analysis of the associations with treatment failure (either no virological result or unsuppressed viral load) at 12 months. In the univariable analysis, patients older than 40 years were less likely to have treatment failure (OR=0.57; 95% CI=0.36-0.89). However, marital status, socio economic status, gender, migration status, WHO stage, NRTIs, CD4 count, education, occupation, living alone, language, and nationality were not statistically associated with treatment failure. Among the social capital variables, social capital composite was associated with a lower risk of treatment failure (OR=0.59; 95% CI=0.37- 0.97). In the multivariable model, after controlling for age, marital status, socio-economic status and NRTI regimen, social capital was still associated with a lower risk of treatment failure (OR=0.52; 95% CI=0.32-0.88). There was a trend towards an association of higher social capital with lower treatment failure (p-trend =0.05).

Although social capital is a composite indicator/predictor, it has been shown to have characteristics that have the ability to hide certain disparities in terms of analysis. For instance, the results revealed that patients with medium trust and solidarity social capital are almost twice as likely (OR=1.68, 95% CI =1.02 – 2.74) to experience treatment failure compared to patients with low trust and solidarity. In addition, patients with medium collective actions and cooperation have about 30% (OR = 0.69, 95% CI= 0.45 – 1.087) reduced risk of experiencing treatment failure compared to patients with low collective actions and cooperation. Such information cannot be obtained by simple analyses using the composite indicator.

Table 6. Univariable and Multivariable logistic regression analyses model for treatment failure (VL>400 copies or no viral load) at 12 months. (N=942)

Variables	Total		Treatment Failure		Univariable			Multivariable		
	N	%	n	%	OR	95% CI	P Value	OR	95% CI	P Value
Age (years)							**Pt*= 0.01**			**Pt*= 0.58**
<30	100	11	41	41	1 (Ref)		-	1 (Ref)		-
30 - 40	412	44	139	34	0.72	0.46-1.13	0.16	0.52	0.24- 1.14	0.11
>40	430	46	121	28	0.57	0.36- 0.89	0.01	0.59	0.27- 1.31	0.20
Gender										
Male	277	29	90	33	1 (Ref)		-	-		-
Female	665	71	211	32	0.94	0.70-1.27	0.70	-		-
Marital status										
Married	242	26	77	32	1 (Ref)		-	1 (Ref)		-
Partner	101	11	34	34	1.11	0.68-1.82	0.68	0.95	0.42- 2.14	0.91
Widow/widower	109	12	23	21	0.62	0.36-1.05	0.07	0.68	0.31- 1.47	0.33
Divorced	73	8	22	30	1.00	0.57-1.77	0.99	0.98	0.42- 2.28	0.97
Single	417	44	145	35	1.15	0.82-1.62	0.41	0 .78	0.46- 1.33	0.37
Nationality										
South African	871	92	281	32	1 (Ref)		-	-		-
Others	71	8	20	29	0.82	0.48-1.41	0.48	-		-
Living (with)										
Partner	183	19	56	31	1 (Ref)		-	-		-
Alone	759	81	245	32	1.12	0.79-1.58	0.54	-		-
Language										
Sesotho	172	18	51	30	1 (Ref)		-	-		-
Xhosa	67	7	24	35	1.32	0.73-2.41	0.36	-		-
Sepedi	106	11	39	37	1.38	0.83-2.31	0.22	-		-
Zulu	291	31	82	28	0.93	0.61-1.41	0.74	-		-
Tswana	176	19	58	33	1.16	0.74- 1.84	0.51	-		-
Others	130	14	47	36	1.34	0.82- 2.18	0.23	-		-
Education										
Primary	94	10	26	28	1 (Ref)		-	-		-
Secondary	465	49	160	34	1.30	0.81-2.12	0.29	-		-
undergraduate	383	41	115	30	1.05	0.64-1.73	0.84	-		-
Migrant										
Citizen	675	72	82	31	1 (Ref)		-	-		-
immigrant	267	28	219	32	0.92	0.68-1.25	0.61	-		-
Occupation										
Unemployed	496	53	180	34	1 (Ref)		-	-		-
Employed	446	47	121	30	0.90	0.68- 1.18	0.44	-		-

Socio-economic status										
High	131	32	50	38	1 (Ref)		-	1 (Ref)		-
Medium	258	63	80	31	0.68	0.44- 1.05	0.09	0.67	0.43- 1.07	0.10
Low	23	6	9	39	1.00	0.41-2.50	0.99	1.11	0.44- 2.82	0.82
WHO stages										
Stage 1	176	19	50	28	1 (Ref)		-	-		-
Stage 2	247	26	89	36	1.42	0.93-2.16	0.10	-		-
Stage3	337	36	103	31	1.11	0.74-1.66	0.61	-		-
Stage 4	182	19	59	32	1.21	0.77-1.90	0.41	-		-
NRTI regimen**										
Zidovudine(AZT)	104	11	28	27	1 (Ref)		-	-		-
Tenofovir	823	87	268	33	1.31	0.83-2.07	0.25	-		-
Stavudine (D4T)	15	2	5	33	1.36	0.42-4.32	0.61	-		-
NNRTI regimen**										
Efavirenz	454	49	133	29	1 (Ref)		-	1 (Ref)		-
Nevirapine	468	51	162	35	1.28	0.97-1.69	0.08	1.32	0 .86- 2.04	0.21
Group and Network										
Low	146	33	59	40	1 (Ref)		-	-		-
Medium	210	47	66	31	0.68	0.44 – 1.05	-	-		-
High	93	21	26	28	0.57	0.33 – 1.00	-	-		-
Trust and Solidarity										
Low	110	25	30	27	1 (Ref)		-	-		-
Medium	24	54	93	39	1.68	1.02 – 2.74	-	-		-
High	98	22	28	29	1.06	0.58 – 1.96	-	-		-
Collective Action and Cooperation										
Low	119	27	47	40	1 (Ref)		-	-		-
Medium	303	68	95	31	0.69	0.45 – 1.08	-	-		-
High	26	6	9	35	0.81	0.33 – 1.97	-	-		-
Social Capital							**Pt*= 0.05**			
Low	118	26	51	43	1 (Ref)		-	1 (Ref)		-
Medium	222	50	68	30	0.59	0.37-0.97	0.02	0 .52	0.32- 0.88	0.02
High	108	24	32	45	0.62	0.36-1.08	0.09	0 .58	0.32- 1.05	0.07
CD4 baseline										
<200	939	100	301	32	1 (Ref)		-	-		-
200	4	0	1	25	0.71	0.07- 6.82	0.76	-		-

***P trend**

Table 7 shows the results of the analysis of the summary of treatment outcomes by social capital groups. The mean score for group and network social capital was lower in patients with treatment failure compared to those with treatment success (P=0.01). Although not statistically significant, mean scores for group and network social capital was lower in patients with unsuppressed viral load compared to those with suppressed viral load (P=0.63) and lower in patients with visit non-adherence compared to those with visit adherence (P=0.32). Mean scores for trust were not significantly different by outcomes.

The mean score for collective action showed a trend for being lower in patients with visit non-adherence compared to those with visit adherence (P=0.08), although not statistically significant. It was also lower in patients with unsuppressed viral load compared to those with suppressed viral load (P=0.06), and also in those with treatment failure compared to treatment success (P=0.06).

Table 7. Summary of Treatment Outcomes by Social Capital Groups

Treatment outcome	Total		Group and network[a]		Trust and Solidarity[b]		Collective action and Cooperation[c]		Social Capital[d]	
	N	%	Mean	P. value	Mean	P. value	Mean	P. value	Mean	P. value
Suppressed	641	68	5.04	0.63	3.72	0.17	10.14	0.06	18.93	0.07
Unsupressed	302	32	4.81		3.19		9.42		17.44	
Adherence	759	81	4.81	0.32	3.68	0.57	10.04	0.08	18.56	0.10
Non-adherence	179	19	4.38		3.48		9.38		17.24	
Treatment success	641	68	5.04	0.01	3.71	0.54	10.15	0.06	18.93	0.01
Treatment failure	302	32	4.23		3.54		9.62		17.41	

a. Measured by the number of organizations to which the respondent belongs, maximum score 16.
b. Measured on the levels of trust generally (5) and then with different groups i.e. neighbours, strangers, newspapers, national leaders and police (25), maximum score 30.
c. measured by asking questions about ability to borrow money (5), volunteering time (5), volunteering money (5) and having someone to take care of one's children (5), maximum score 15.
d. Measured as the combination of group and network, trust and solidarity, collective action and cooperation (i.e. group-network score+ trust-solidarity score+ collective action-cooperation score), maximum score 61.

Assessment of the logistic model

3.3 Treatment Failure

After comparing the final model that included social capital, age, employment and marital status (Model E) with the first model (Model A) that included only social capital, the chi-square result was 4.57 (P = 0.599). There is not enough evidence to reject the null hypothesis that Model E was an improvement of Model A. We then used the Hosmer and Lemeshow goodness of fit test for the final model, and found that the Pearson chi-square test statistic was 49.47 with a P-value of 0.807. We did not reject the null hypothesis and therefore concluded that the fitted final model was reliable.

Table 8. Model evaluation

	Visit Non-adherence		Treatment Failure		Unsupressed Viral Load	
Covariate	**AOR**	**95% CI**	**AOR**	**95% CI**	**AOR**	**95% CI**
Social Capital						
Low	1 (Ref)		1 (Ref)		1 (Ref)	
Medium	0.93	0.47 – 1.84	0.56	0.35-0.88	0.49	0.26-0.93
High	0.82	0.36 – 1.86	0.59	0.34-1.03	0.58	0.27-1.22
Socio-economic Status						
High	1 (Ref)					
Meduim	0.61	0.34-1.08				
Low	-					

3.4 Unsuppressed Viral Load

The final model with age, marital status, employment and social capital (Model F) compared to Model A that only included social capital. The chi-square test statistic was 4.18 (P = 0.759). In the Hosmer and Lemeshow goodness of fit for the final model, we found that the Pearson chi-square test result was 36.77 (P= 0.982). We failed to reject the null hypothesis and therefore concluded that the final fitted model was reliable.

3.5 Non-adherence

The final model with social capital and socio-economic status (Model B) compared with the first Model (Model A) from the likelihood ratio test, however, shows that Model B (with social capital and socio-economic status) gave a marginal significant improvement over Model A: Chi^2 =2.74 (P= 0.097).

4 DISCUSSION

This is one of the few studies that have looked at social capital and HIV treatment outcomes in South Africa, and the only one that has used a method of scoring of social capital to show the effect of social capital on HIV/AIDS patients. Social capital benefits communities by encouraging togetherness and assists people suffering from chronic diseases to improve their wellbeing. Chronic diseases are accompanied by emotional and behavioural changes, depression and negatives feelings. Thomas and Thomas (1999) suggested that a community's social capital can be used as a tool to prevent HIV "by enhancing the skills of people in a community and providing them with opportunities and resources to care and advocate for one another" (Thomas and Thomas, 1999). Cattell (2001) and Kawachi et al. (1997) postulated that people with increased social capital cope better with stress and live longer than those with low social capital. In other words, low social capital is perceived as a factor for increased rate of morbidity.

In this study, people who were members of religious organisations or who benefited from employment, also enjoyed the extended benefits provided by these factors through social engagements. A typical example is workplace social capital which has been known to serve as a buffer. What this means is that people can rely on a friend at work to loan him/her money in the event of needing cash to cover some expenses.

South Africa has one of the largest ART programmes in the world yet only a few studies on social capital and HIV treatment have been conducted. From general observations, I had suggested that South Africa does not have a well-structured social system compared to other African countries where people are more social. This argument can be supported by Seekings' (2003) findings on how South African health statistics are published. For instance, they are published in racial categories, with little or no regard for the level of inequalities that exists amongst these racial groups. His research also shows that there is very little idea as to how class, however defined and measured, affects health. He pointed to the importance of class in South Africa from a perception that people did not choose their class, when considering the country's racial history (Seekings, 2003). His findings mirror several aspects of South African society and the lack of a well-structured social system. Some of the key factors that have created these weak social systems are racial and economic inequalities.

There are more social activities in other African countries compared to South Africa because the culture and ethnic groups of the populations in other countries have similarities. Social capital has also highlighted social inequalities which have been well-documented in South Africa. Seekings' research on class categories supports this claim (Seekings, 2003). Other research such as that by Wilkinson (1996) argued that socioeconomic inequality affects people's health because it erodes social capital. A study by Campbell et al. (1999) on social capital and health suggested that social capital can act as a buffer against socioeconomic disadvantage by reducing the effect of a lack of economic resources. Thomas (1999) argued that social capital is necessary for a community to be healthy (Thomas and Thomas, 1999).

What we have seen from state interventions, are programme initiatives to reverse these negative trends. These initiatives include education and awareness in preventing the spread of HIV/AIDS, and ART. The implementation of social groups and networks can make a significant difference as we have seen in the case with people with cancer in the US overcoming their ailments (Sapp et al., 2003). Participation in social networks and groups created enabling environments to talk about their illnesses and get support. They had reasons to fight to survive and ensure their own well-being. These networks and groups encouraged them to continue with their therapy. Words of encouragement from their social engagements had positive outcomes and served to reinforce the benefits of social capital. We see the element of a growing self-esteem and confidence derived from people participating in groups. The example from the US by Sapp et al. (2003) provides evidence that social capital has produced clear benefits and has significantly contributed to the well-being of people with chronic diseases in communities.

There are several well-documented reports on the benefits of social capital in communities with people struggling with chronic illness. This evidence is reflected in the work of Cattell (Cattell, 2001) and Runyan (Runyan et al., 1998). Social capital can assist HIV-infected persons to talk about their condition. By talking within networks or groups, people living with HIV can be assisted to overcome the social stigma associated with the ailment. They are encouraged to seek help through treatment and counselling.

Miliband (2006) pointed to expressions of civic engagement within social networks that have created norms that tend to encourage people. These social engagements can be linked to acquaintances that provide assistance that help people gain employment and trust. The trust factor had usually influenced and encouraged people in groups to collaborate. There is also a certain amount of commitment on the part of people in groups to respect each other. They tend to adopt behavioural attitudes characterised by the willingness to share and take action when they see antisocial tendencies in their group or communities. From these social engagements, they are able to get advice on a host of health-related issues, including diets and physical activities. The outcomes from these social engagements have made a marked difference when comparing people living with

HIV/AIDS who have networks and groups that provide the platform to talk with those who do not have. People living with HIV who have no social engagements and no platform to talk normally withdraw into themselves and are often never better. They tend to become depressed and grow even sicker.

Social capital can strengthen awareness amongst communities about the danger of HIV/AIDS. Measham and Brain (2005) were keen to stress that, in today's social climate, it is normal to target resources that have, as their objective, the strengthening of social capital. In most modern societies today, commutators argue that traditional norms that include occupational stability, class-based communities and the family (seen as the nuclear of societies) are the foundation on which social capital has been nurtured. This has made social capital even more relevant in influencing positive health outcomes. Social capital has helped in educating communities by advocating life styles that, in turn, have reduced exposure and infection rates.

In countries such as Uganda, Tanzania, etc., social capital has had a major influence on keeping HIV/AIDS patients on ART programmes (Mills et al., 2006). The outcomes from social engagements in these countries have encouraged patients to support each other through networks and group memberships. Social capital has also contributed to the decline in rates of infection.

Social capital is a difficult concept to understand as it consists of different ways of measurement and has a variety of definitions. Several studies have identified useful proxy measurements for social capital using different types and combinations of qualitative, quantitative and comparative research methodologies. Webel et al. (2012) classified a mean social capital score higher than 2.5 as high social capital and anything less than 2.5 as low social capital. When compared to findings from our study, social capital was relatively high with a score of 17.41 to 18.93. The mean social capital score was greater than 2.5, although there is not a standard measure for social capital.

In this study, demographic factors associated with high social capital were older age and being employed. Because these people have built networks during their lives, they have families, children and friends, and are member of different networks and associations. These networks and associations include sport groups, leadership groups, etc. and would have increased their confidence given their age. Employed people are members of their workplaces where they have more chances to meet and interact with people. We also found that increased social capital was associated with lower risk of unsuppressed viral load and lower risk of treatment failure at 12 months in the univariable and multivariable analysis. However social capital was not associated with visit non- adherence.

4.1 Social capital and unsuppressed viral load (>400 copies/ml)

Older age (>40 years) and being employed were associated with lower risk of unsuppressed viral load at 12 months. After controlling for confounders, those in the medium and higher social capital groups were less likely to have an unsuppressed viral load compared to those in the low social capital group; however, the funding in high social capital group was not statistically significant.

This study is the first to show that social capital is linked to a lower risk of having an unsuppressed viral load for those individuals on ART. Although it is known that social capital is likely to contribute to positive ART outcomes.

Findings from this study provide evidence suggesting that people who are open about their ailments and who have the forum to talk about them have better outcomes. They developed self-esteem and confidence. This situation is similar to a study with cancer patients reported in the US (Sapp et al., 2003). By talking about their conditions, patients were able to overcome their ailments. A similar outcome can be seen in people who continue their therapy and improve their well-being. They derived encouragement from members in their networks and groups and advised on diet and physical exercise.

4.2 Social capital and treatment failure (missing viral load)

Our study also revealed that patient's low socio economic status, as well as being on an Nevirapine regimen, were associated with treatment failure. Social capital was found to be associated with treatment failure before and after controlling for confounders. Individuals with middle and higher social capital had a lower risk of treatment failure.

4.3 Social capital and visit non-adherence

Tenofovir regimen was found to be associated with visit non-adherence in this study population. We found that participants in the study group with low and middle socio-economic status were reportedly more likely to be non-adherent to ART, when compared to participants of high socio-economic status. This finding is considered true when we compare participants of high-socio economic status with those of low and middle socio-economic status regarding level of inequality in income because poor communities invariably suffer from poor health and these same communities also suffer from lack of employment opportunities and, therefore, income.

Transportation attracts cost and places a significant burden on patients. Unemployed patients tend to travel very long distances to attend clinic sessions and they cannot afford to pay for their transportation.

It is known that the lack of knowledge about HIV/AIDS and treatment programmes creates enormous amounts of fear. Social stigma caused by ignorance and the fear of being seen by other people may explain the non-adherence to ART. This is the same for knowledge deficit as a problem of non-disclosure that also leads to non-adherence to ART.

Tenofovir being associated with non-adherence could be due to side effects, such as nausea, asthenia, headache, renal insufficiency. Social capital was not associated with visit non-adherence by patients enrolled in the ART program in the univariable and multivariable analysis.

4.4 Limitations

The primary study from which these data were obtained had some limitations. The first was the timing of the interviews. Social capital was measured at one time point but outcomes were measured at 12 months after the start of ART. There was an assumption that the social capital measured at that time point remained constant while the person was on ART. Nevertheless, the study design provided prospective data on a sample of patients that would not have been available in a cross-sectional study.

The issue of HIV support groups or 'treatment buddies' was not addressed in the primary study. These have the potential of contributing substantially to social capital but this oversight could not be corrected in this secondary data analysis.

Another limitation of the primary study is that it included only patients who were at the study clinic and available for interview. We are therefore likely to have overestimated treatment success due to selection bias. However, our study is not aimed at understanding treatment success but rather at understanding social capital and its effect on treatment success. Nevertheless, we could not measure social capital on those who had already left the programme.

As we did not have validated tools for social capital, we used modified social capital scores. This made it difficult to compare the findings from this study with those from other studies.

These analyses assumed that all those with missing viral load results were treatment failures. We assumed that the reason for missing viral load results is that patients did not return for their viral load visits, but there may have been other reasons, such as problems with the laboratory and data management system.

Finally, as this our study was not a clinical trial we did not have a control group to take care of all confounders. Nevertheless, we did adjust for those confounders that are commonly associated with the outcomes of interest. Social capital, as a topic, does not lend itself to a clinical trial design.

5 CONCLUSIONS AND RECOMMENDATIONS

This study is the first to investigate the association between social capital and HIV outcomes in South Africa. The results are consistent with those from studies conducted elsewhere in the world but there remains much to learn, and using standardised and validated tools might improve the validity of futures studies.

In view of the findings, we highlight some recommendations that included, but are not limited to, the following:

We recommend that health care providers focus on younger age groups by promoting youth organisations and family support to reinforce social capital in the young population. In the case of unemployed people, where social capital is likely to be low, clinic staff should be made aware of this so that they can take steps to introduce measures that would encourage more social participation among unemployed patients. Social capital will not, itself, directly lead to job creation. However, it will help to ensure that communities in which unemployment rates are high do not struggle with additional difficulties related to lack of social capital. If we consider the clinic staff as agents that can encourages social participation and engagement in communities where

unemployment is high and social capital is low, their actions are very likely to create a more conducive environment for investment and job creation.

There is a strong case for clinic staff to promote social capital and be aware of the importance of social capital; they can also include other measures to help patients with low social capital.

While there is little evidence to suggest that these recommendations could hold true, they do leave room for further exploration of the association of social capital and HIV/AIDS treatment outcome.

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7 APPENDIXES

Appendix 1: Questions Pertaining to Social Capital

Questions relating to Social Capital, incorporated in questionnaire administered by AURUM for study to Determine Site-level Factors Which May Determine Clinical Outcomes on Antiretroviral Therapy (ART) in Patients Attending Primary Health Clinics in South Africa

"I would like to start by asking you about the groups or organizations, networks, associations to which you belong. These could be formally organized groups or just groups of people who get together *regularly* to do an activity or talk about things. Groups can be lik*e a religious group mosque / church / shul / temple, savings club, burial society, political party, trade union, sport club, youth group, volunteer with police/fire brigade; residence association, women's group, school committee, traders group, music group"*

Of how many such groups do you or members of household a member? .....□□ Of all these groups to which you or members of your household belong, which one is the most important to you household? _____ [Name of group / type]
Thinking about the members of this group, are most of them of the same RELIGION (1=Yes, 0=No).....□ GENDER (1=Yes, 0=No).....□ RACE (1=Yes, 0=No).....□ ETHNIC/LINGUISTIC BACKGROUND (1=Yes, 0=No).....□ OCCUPATION (1=Yes, 0=No).....□ EDUCATION BACKGROUND/QUALIFICATIONS) (1=Yes, 0=No).....□

About how many *close friends* do you have these days? These are people you feel at ease with, can talk to about private matters, or call on for help…….....□□
If you suddenly needed to borrow a small amount of money [RURAL: enough to pay for expenses for your household for one week; URBAN: equal to about one week's wages], are there people beyond your immediate household and close relatives to whom you could turn to and would be willing and able to provide this money?.....□ 1= Definitely 2= Probably 3=Unsure 4=Probably not 5=Definitely not
If you suddenly had to go away for a day or two, who would take care of your children? (give answers that apply) **..……..……..…□** **……..…□** 1= Blood relative (brother, sister, father, mother) 2= Other relatives (e.g. in-laws) 3= A non-relative close friend 4= Neighbour 5= Work colleague 6= Member of a group you belong to 7= No one
Generally speaking, would you say that most people can be trusted (Yes=1, No=0?).....□
If a community project does not directly benefit you but has benefits for many others in the village/neighbourhood,

Would you contribute time to the project? (Yes=1, No=0?).....□

Would you contribute money to the project? (Yes=1, No=0?).....□

What is the level of trust between in community and the following types of people or groups?

1=No trust

2=Low trust

3=Medium trust

4=High trust

5=Complete trust

Neighbours.....□

Local leaders.....□

Strangers.....□

Newspaper/radio/TV.....□

Local government.....□

Provincial government.....□

National government.....□

National leaders.....□

Police.....□

Security services …......□

Appendix 2: Ethics clearance certificate

R14/49 Dr Grace Mukoswa

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M130249

NAME: (Principal Investigator)	Dr Grace Mukoswa
DEPARTMENT:	School of Public Health Medical School
PROJECT TITLE:	Association between Social Capital and HIV Treatment Outcomes
DATE CONSIDERED:	22/02/2013
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Dr Gill Nelson
APPROVED BY:	Professor PE Cleaton-Jones, Chairperson, HREC (Medical)

DATE OF APPROVAL: 22/02/2013

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**.

Principal Investigator Signature Date 11/05/2013

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES